INSTITUTO
UNIVERSITÁRIO
DE LISBOA

UNIVERSITÀ
DEGLI STUDI
DI PALERMO

Title: How sustainability drives new venture investments: the moderating role of Certificates

Marco Lauricella

Master in Management of Services and Technology

Supervisor:

Prof. Giovanni Perrone, Ordinary Professor,
Università degli studi di Palermo

October, 2023

Department of Marketing, Strategy and Operations

Title: How sustainability drives new venture investments: the moderating role of Certificates

Marco Lauricella

Master in Management of Services and Technology

Supervisor:

Prof. Giovanni Perrone, Ordinary Professor,
Università degli studi di Palermo

October, 2023

RESUMO

Português:

Esta tese explora o papel das startups e dos certificados sustentáveis (uma política governamental) na influência dos investimentos de capital de risco independente (IVC), capital de risco empresarial (CVC) e capital de risco governamental (GVC), no contexto das crescentes preocupações climáticas e ambientais. A análise da literatura destaca a importância da sustentabilidade e as características destes tipos de investidores. Introduz também o Índice de Rigor da Política Ambiental (EPS) da OCDE.

Para colmatar as lacunas de investigação existentes, o estudo utiliza um conjunto de dados de 368 empresas em fase de arranque, 722 observações, abrangendo o período de 2010-2022, com 25 variáveis. A análise estatística é efectuada com recurso ao software STATA.

Os resultados são os seguintes:

IVC: A sustentabilidade afeta negativamente as decisões desses investidores. A variável moderadora Certificados não influencia esta tendência.

CVC: A sustentabilidade não parece afetar as decisões dos CVCs, e a moderação com a variável Certificados não altera esse resultado.

GVC: Este tipo de investidor é fortemente influenciado pela Sustentabilidade. O efeito de moderação da variável Certificados com a sustentabilidade não foi significativo.

Em conclusão, a sustentabilidade é um fator determinante para os investimentos em IVC e GVC, mas não influencia as decisões dos investidores em CVC. Os certificados não têm muita influência na probabilidade de as startups sustentáveis receberem investimentos de investidores de IVC, CVC e GVC.

Classificação JEL: G24 Capital de risco; Q56 Sustentabilidade

Palavras-chave**:** Ambiente e Desenvolvimento, Sustentabilidade, Capital de Risco

ABSTRACT

English:

This thesis explores the role of startups and sustainable certificates (a government policy) in influencing the investments of independent venture capital (IVC), corporate venture capital (CVC), and government venture capital (GVC), in the context of growing climate and environmental concerns. The literature review highlights the significance of sustainability and the characteristics of these investor types. It also introduces the Environmental Policy Stringency (EPS) Index by OECD.

To fill existing research gaps, the study employs a dataset of 368 startups, 722 observations, spanning 2010-2022, with 25 variables.

Statistical analysis is conducted using STATA software. Results are as follows:

IVC: Sustainability negatively affects the decisions of these investors. The moderator variable Certificates does not influence this trend.

CVC: Sustainability does not seem to affect CVCs decisions, and moderation with the Certificates variable does not change this result.

GVC: This type of investor is strongly influenced by Sustainability. The moderation effect of the Certificates variable with sustainability has not been significant.

In conclusion, sustainability is a driver for IVC and GVC investments, while it does not influence the decisions of CVC investors. Certificates does not have much influence on the likelihood of sustainable startups to receive investment from IVC, CVC, and GVC investors.

JEL classification: G24 Venture Capital; Q56 Sustainability

Keywords: Environment and Development, Sustainability, Venture Capital

SUMMARY

TABLE OF CONTENTS AND FIGURES:

GLOSSARY

UNFCCC - United Nations Framework Convention on Climate Change

M&A – Merger and acquisition

IVC – Indipendent venture capital

CVC – Corporate venture capital

GVC – Government venture capital

EPS – Environmental Policy Stringency index

OECD - Organization for Economic Cooperation and Development

CoPs - Conferences of the Parties

VC – Venture capital

MBP - Market-Based Instruments

NMBP - Non-Market-Based Instruments

TS - Technology Support

Nox - Nitrogen Oxides Tax

Sox - Sulphur Oxides Tax

ELV - Emission Limit Value

IPO - Initial Public Offering

SUST – Sustainability

US – United States

1. INTRODUCTION

In recent decades, sustainability has become one of the most pressing and important issues facing the future of our planet. To ensure a healthy and prosperous future for the next generation, it is important to balance economic growth, social development, and the conservation of our planet's resources (R Goodland, 1995).

The environmental and climate issues started to gain prominence in the late 1970s. The first World Climate Conference was convened in Geneva in 1979 with the intention of assessing the current state of the global climate and how it has changed through time. Since then, efforts have been made around the world to deal with the obvious environmental problem.

Numerous conferences, treaties and agreements were held in the following years. For example, some of the most important include the Earth Summit in Rio de Janeiro in 1992 in which the United Nations Framework Convention on Climate Change (UNFCCC) was born. Then, in 1997, the Kyoto Protocol was signed, which is the first international sustainability agreement that commits industrialized economies to reduce greenhouse gas emissions.

Another significant step was taken in 2016 with the signing of the Paris Agreement, an unprecedented global commitment to "fight" climate change. The goal of the Paris Agreement is to limit the rise in average global temperature "well below" 2 degrees Celsius. These events are just some of the crucial milestones in the field of environment and sustainability that have helped shape international policy and action to address the challenge of climate change.

The role of businesses, particularly startups, is critical toward the transition to a more sustainable economy. To provide sustainable solutions that can help meet the environmental and climate goals set by government laws, technological advances and sufficient investment are needed (Boar-Boar & Oliveras-Villanueva, 2019).

Many studies have shown how sustainable entrepreneurship is greatly influenced by the key role played by startups. Indeed, it has been demonstrated how new entrants, in contrast to incumbents, are more likely to pursue sustainability-related goals. It was analyzed how many of the radical innovations in the market that produce environmental benefits come from startups themselves. Many research shows that startups are perfect "catalysts" for incumbent innovation, which through forms of open innovation, such as M&A or Venture Capital programs, are able to innovate by accessing the knowledge and technologies developed by startups (Boar-Boar & Oliveras-Villanueva, 2019; H. Chesbrough, 2012; Jannic Horne, 2022). In addition, sustainable startups often encounter many obstacles in obtaining funding, due to uncertainty of success,

high costs to develop new technologies and longer timeframes to achieve long-term goals (Linnanen, 2002).

What is the role of sustainability and environmental policies in venture investments?

The purpose of this thesis is to investigate the role of sustainability and government policies in promoting and supporting investments by 3 types of Venture Capitalist: Independent Venture Capital (IVC), Corporate Venture Capital (CVC), and Government Venture Capital (GVC). Through an econometric analysis on a sample constructed ad hoc for this study, the study verifies whether sustainability can be considered a driver for these types of investors and what kind of role environmental policies play in this relationship.

In particular, the paper analyzes the moderating effect of *Certificates*, a government policy derived from the Environmental Policy Stringency (EPS) index and developed by the Organization for Economic Cooperation and Development (OECD).

This study not only provides a rare opportunity to examine the convergence of the public and private sectors in the area of sustainability, expanding the literature, but it is also in line with the goals of the European sustainability agenda and the Conferences of the Parties (COPs).

2. LITERATURE REVIEW

The first chapter is divided into 6 sections. The first defines the characteristics of Sustainable startups, their role for innovation, performance and challenges.

The second chapter analyzes the three forms of investment used in this study: IVC, CVC and GVC. The third and fourth chapters introduce the OECD and related government policies of interest to this research.

Finally, the literature gap is described. In particular it is necessary to further explore the role of sustainability and government policies on VCs' decisions.

2.1. Sustainable startups

Sustainability has become a crucial topic for businesses these days as the world faces increasingly complex and interconnected challenges related to the environment, such as climate change and biodiversity loss, problems that require a collective response (Ioannis Ioannou and George Serafeim, 2014).

In recent years, companies need to consider other factors, such as stakeholders' expectations (Holger Patzelt Dean A. Shepherd, 2011). This has a major impact on business decisions, as they expect organizations to create not only economic and social benefit, but also environmental benefit, by not focusing all resources only on short-term profits.

At the same time, when companies evaluate their business methods based on sustainable criteria, innovative solutions often emerge opening up new business prospects that companies can exploit. (Bendig et al., 2022).

Therefore, sustainable companies must develop a "triple bottom line" business model, balancing three key factors: Economic profit, Environment and Social welfare.

The concept of economic profit refers to the company's ability to generate earnings, creating financial value for investors and shareholders. Environmental aspect refers to the organization's responsibility to the environment and sustainability, with actions such as pollution reduction and sustainable waste management. Social welfare refers to the company's contribution to the welfare of society as a whole, including aspects such as equality in employment opportunities and corporate social responsibility (Bocken, 2015).

According to the triple bottom line principle, these types of startups generally aim to strike a balance between economic growth, environmental impact, and social impact, evaluating the

company's strategic decisions not only on the basis of their future financial viability, but also on their social and environmental impact (Hockerts & Wüstenhagen, 2010).

2.2.1. Performance of sustainable startups

Startups, unlike large incumbent companies already operating in the market, have a more dynamic and less entrepreneurial management style, making them perfect springboards for sustainable innovations (Bos-Brouwers, 2010).

This is due to the inherent characteristics of startups, such as resources at hand, agility in change, and no reporting priorities.

Startups organize the limited resources they have creatively, with the goal of finding innovative solutions. This generates more efficient and environmentally friendly ways to achieve their goals, making sustainable innovation easier to achieve.

Compared with large market players, the structure of innovation in startups is less formal and hierarchical, allowing a freer flow of ideas in a less rigid environment in which innovation can easily make its way. In fact, incumbents, who have a richer resource base and a more mature enterprise, tend to focus more on their core business, with continuous improvement of the same, neglecting emerging technologies and markets (Bendig et al., 2022; Giulio Cainelli, 2015).

Because startups are often in the early stages of development, they can focus on long-term goals such as sustainability without having to follow strict quarterly reports. Entrepreneurs easily start with sustainable goals, but as the company grows, the pressure for price and quality can diminish their commitment to sustainability(Hockerts & Wüstenhagen, 2010).

2.2.2. Challenges of Sustainable startups

In addition to the advantages of startups just described, it is also worth noting the challenges. In fact, studies have looked at how these companies may have more difficulty finding financial support from more conventionally business-oriented companies (Linnanen, 2002), as sustainable companies, unlike typical startups, have motivations, goals and knowledge that are unlikely to be business-oriented (Shepherd & Patzelt, 2011).

In Markard's article, through the case study of an emerging company called Better Place (a company that developed and sold battery charging services for electric cars), additional factors that can hinder the success of sustainable startups are analyzed, such as the extreme uncertainty

of the markets in which they operate, collective action issues, market infrastructure and regulation, long development times, and the transition from niche to mass market (Markard et al., 2012).

Sustainable startups often operate in uncertain sectors with rapid changes in customer preferences, technology and regulations. Lack of adequate infrastructure and laws can hinder the growth of these markets. Information asymmetry, related to fundraising, can discourage investors if they do not fully understand the environmental and social goals of new companies (Bocken, 2015).

2.3. Type of fundings and investments for sustainable startups

Sustainable investment, or "impact investment," is a new concept when it comes to technology investments made to improve the quality of a company's sustainability. These types of investors move among so-called "sustainable investments" with the aim of generating benefits in terms of the "triple bottom line" (Bocken, 2015).

Startups in the world of entrepreneurship need funding and support in order to develop and prosper.

Funds can come from different types of investors, such as Venture Capitalist, incubator and accelerator organizations or programs, private equity firms, and other types, but this study analyzes only investments made by three types of venture capitalists: Independent Venture Capital (IVC), Corporate Venture Capital (CVC) and Government Venture Capital (GVC).

Venture capitalists' investments in green startups are positively correlated with their performance in green innovation, conferring competitive advantages to large companies through lower costs and speed of innovation. These investments can also be strategic choices for developing industry-relevant resources (Bendig et al., 2022)

2.3.1. IVC

IVCs are often structured as limited partnerships, with the investment process being overseen by a separate management firm that is not affiliated with the final investor. In actuality, IVCs are indipendent investors or investor groups who oversee separate venture

capital funds that are not associated with any one institution or corporation (Bertoni & Tykvová, 2015; Colombo & Murtinu, 2015).

They function similarly to a VC fund management organization, raising money from outside investors before directing it to startups or rising businesses.

Independent venture capitalists' main objective is to provide financial returns, some of which go to the venture capital firm's limited partners (Bertoni and Tykvová 2015; Colombo and Murtinu 2017).

IVC companies offer value-added services to the portfolio company in addition to financial support. Independent venture capital firms have significant incentives to aggressively help the portfolio company since independent venture capitalists are particularly interested in substantial financial returns. They offer the portfolio company, for instance, special connections to qualified employees and possible suppliers or customers (Bertoni & Tykvová, 2015; Luukkonen et al., 2013).

The most common type of VC on the market is IVC. A significant portion of the writing on the VC is focused on the IVC (Wang, 2022).

IVCs prefer young, small startups in less competitive locations for their low-risk growth potential. They may also seek to stimulate innovation and work in such areas through these investments.

2.3.2. CVC

CVCs are investment platforms used by non-financial businesses. In addition to finance, the parent firm also provides the portfolio companies with physical or intangible resources (Colombo & Murtinu, 2015).

CVCs can offer their portfolio companies specialized information from the parent company, such as complementing talents, distribution options, or production capacities. Additionally, they can benefit from the parent company's network of contacts and partners in related industries (Colombo & Murtinu, 2015).

In contrast to IVCs, the goals of CVCs do not center largely on financial returns. As opposed to this, they frequently look for technological opportunities that align with the parent company's primary business (Dushnitsky & Lenox, 2005).

In other words, CVC enterprises seek to learn new technologies and source expertise in order to increase the parent company's innovativeness (Wadhwa et al., 2016).

Research indicated that many of the companies use CVCs to pursue a technological goal and many other aim for a financial return. Global CVC activity soared in 2021, with funding at

an all-time high in the first half of the year (Wang, 2022). Nevertheless, many companies are dissatisfied with their results.

2.3.3. GVC

Government venture capital is a type of financing made available by a government or its agency to encourage the creation of new businesses and business ventures. Typically, this type of financing takes the form of direct investments or equity stakes in new or developing enterprises (Bianchini & Croce, 2022).

This type of venture capital is primarily controlled by public entities, and what sets them apart from other types of VCs is that GVCs focus their investment choices on achieving specific environmental goals for a nation. As a result, GVCs frequently assist the market they invest in by preventing failure and encouraging the growth of the private VC industry. (Colombo et al., 2016).

GVC investments in early-stage markets reduce information asymmetry, making startups more attractive to IVCs. This "signaling" effect increases the probability of IVC investment, as GVC backing indicates a higher likelihood of future IVC support. GVCs, with their wealth of information, serve as a guarantee for independent VCs. Governments promote cleantech technologies either directly through GVC funding or indirectly through investment, as noted before, according to a study by Bianchini.

This direct intervention is due to governments' desire to alleviate the capital gap for innovative startups (Bianchini & Croce, 2022). As a consequence of what was discussed earlier, another conclusion that studies have reached is that GVCs usually invest more frequently in sustainable technologies than IVCs (Bianchini & Croce, 2022).

2.4. OECD

The OECD, with 38 member countries, is a major global organization interested in sustainability after the 2016 Paris Agreement. Aiming to improve living standards through economic cooperation, the OECD is relevant to understanding the impact of global incentive policies on investment in sustainable startups by IVCs, CVCs and GVCs (OECD.org, 2023).

Public policy, or the government policies and initiatives that are implemented by governments to address issues of public concern and influence the behavior and well-being of society, is one of the OECD's major knowledge areas. Numerous areas and challenges are

covered by public policies; however, in this thesis, we will primarily focus on the economic and environmental ones.

In order to create a strong foundation for effective public policy making in member nations, the organization conducts in-depth research on a variety of topics (like health, education and environment). The OECD additionally offers guidance and support to assist governments in putting these policies into effect (OECD.org, 2023).

2.5. Policies

It is crucial to draw attention to the OECD study on the measuring of environmental policy stringency (EPS) in the specific context of environmental policies. This proves to be a key resource for analyzing and assessing environmental policies implemented by various nations and regions around the world (Botta & Koźluk, 2014).

This index assesses the rigidity of current environmental policies and is crucial in the current global context of environmental challenges and climate change. It considers various factors, including laws, regulations, economic incentives, greenhouse gas emission reduction targets, and water resource management policies (Kruse et al., 2022).

The main objective of the EPS is to assess the effectiveness of a region's environmental policies for conservation and environmental sustainability. This index provides an unbiased assessment of a nation or region's commitment to promoting sustainability and responsible resource management (Botta & Koźluk, 2014).

Stringency is characterized as a cost imposed on activities that pollute or harm the environment, but one of the key challenges for researchers has been the difficulty in comparing this variable between nations.

The OECD researchers identified 13 index policy instruments, classifying them into Market-Based Instruments (MBP), Non-Market-Based Instruments (NMBP), and Technology Support (TS) Policies after overcoming the challenges associated with developing this measure (Kruse et al., 2022).

Through the study conducted by Botta and Koźluk, and Tobias Kruse and Antoine Dechezleprêtre, we analyze the final aggregation of the EPS index with its described in Figure 3 (Botta & Koźluk, 2014; Kruse et al., 2022).

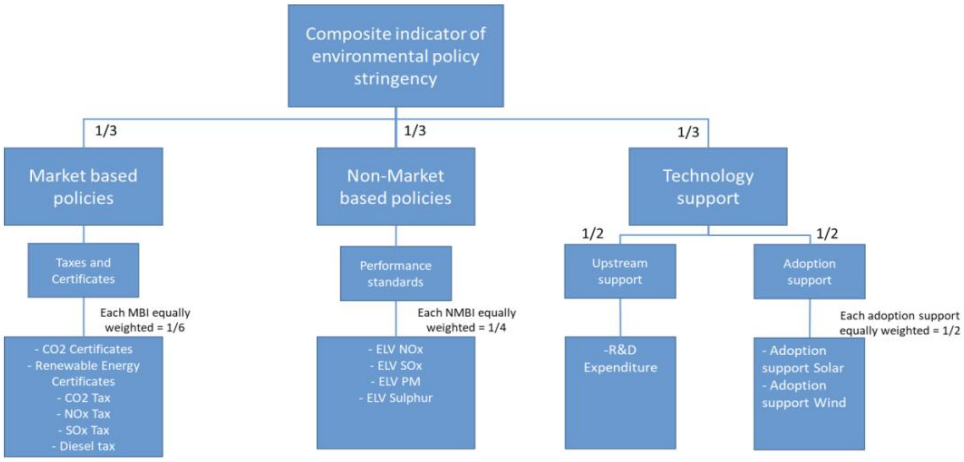

Figure 2.1 The figure shows the aggregation structure of the revised EPS index. The structure of the revised EPS index (Kruse et al., 2022)

2.5.1. Marked Based Policies

Market-based policies use incentives such as taxes and certificates to influence corporate and individual behavior, promoting sustainable resource management and pollution reduction. Certificates are tools used in environmental policy to control greenhouse gas emissions and encourage renewable energy:

- CO2 Trading Schemes: Emission trading systems aim to control CO2 emissions by setting limits for businesses. If a company exceeds its limit, it must buy allowances or pay fines. This system encourages emission reduction and allows companies to profit by selling unused allowances. The average permit price reflects the scheme's stringency, with higher prices indicating stricter policies. Prices are usually converted to dollars per tonne of CO2 for international comparison;
- Renewable Energy Trading Scheme: Renewable energy programs reward the production of clean energy like solar, wind, and hydropower with certificates. These certificates can be purchased by companies to demonstrate their use of renewable energy and meet regulatory requirements, with the goal of increasing the share of green energy in their mix. Stringency of the policy depends on the required green energy percentage.

In the EPS, taxes are referred to be financial tools that environmental policies utilize to control emissions and pollution as well as to encourage more environmentally friendly behavior. The basic objective of these taxes, which are imposed on goods, services, or emissions that affect the environment, is to discourage such behavior.

There are four of our policies that deal with taxes:

- CO2 Tax: The CO2 Tax taxes carbon dioxide emissions from businesses, vehicles and other sources, creating economic incentives to reduce emissions. The rate is based on the amount of CO2 emitted and is converted to U.S. dollars per ton of CO2;
- Nitrogen Oxides (Nox) Tax: Nitrogen oxides (NOx), air pollutants created by cars, industrial facilities, and other sources, are subject to the NOx Tax. The idea is the same as how the CO2 tax operates. Raw national currency values are translated to US Dollars per Liter;
- Sulphur Oxides (SOx) Tax: Sulfur oxides (SOx), air pollutants frequently linked to the usage of fossil fuels high in sulfur, are subject to the SOx Tax. Raw values are translated to USD/tonne Sox from national currencies;
- Fuel Tax (Diesel) : The Diesel Tax taxes only emissions from diesel vehicles, encouraging greener alternatives and reducing diesel use. Rates are expressed in U.S. dollars per liter.

2.5.2. Non-Market Based Policies

NMBP are defined as programs and tools that use direct regulation, prohibitions, non-market-based financial incentives, rules, and environmental legislation to solve environmental challenges. These tools directly impose regulations and limits to achieve environmental goals rather than relying on market functioning to affect stakeholder behavior.

When we talk about performance standards for "non-market-based policies," we mean evaluation standards and metrics used for public policies or government interventions that don't rely on how markets operate or how market mechanisms work to accomplish particular goals. We can find 4 different policies within performance standards:

- Emission Limit Value (ELV) for nitrogen oxides (NOx): Regulations set maximum limits for nitrogen oxide (NOx) emissions from various sources to improve air quality and reduce harmful effects on human health and the environment. Values expressed in mg/m^3;
- ELV for sulphur oxides (SOx): This regulation limits emissions of sulfur oxides (SOx) from various sources to prevent acid air pollution and environmental damage. Values expressed in mg/m^3;

- ELV for Particulate Matter (PM): This regulation imposes maximum limits on atmospheric particulate matter (PM) emissions to protect public health and improve air quality. Values expressed in mg/m^3.
- Sulphur content limit for diesel: This policy limits the sulfur content in diesels, reducing SOx emissions and improving air quality. Values expressed in ppm.

2.5.3. Technology Support (TS) Policies

Technology support (TS) policies promote sustainable technologies through financial incentives, tax breaks and research support. There are two types of policies: "upstream," which supports the initial development of green technologies, and "adoption," which encourages their adoption. The main goal is to stimulate technological innovation for sustainable solutions.
There is just one Policy in this category:

- Public research and development expenditure (R&D): This policy concerns public funding for R&D of sustainable technologies. The goal is to support environmentally beneficial innovation by accelerating the use of green technologies. The measure is obtained from the ratio of national GDP to public spending on R&D, multiplied by 1000 for ease of reading.

Adoption support aims to promote the widespread use of current green technologies through financial incentives, tax breaks and training programs to make sustainable solutions more accessible and affordable. The main goal is to stimulate the adoption of sustainable technologies in the marketplace while reducing their environmental impact.

Within this category we have 2 policies, namely Renewable energy support for Solar e Renewable energy support for wind:

- Renewable energy support for Solar: This policy promotes the use of renewable solar energy through incentives such as FIT and special auctions. The indicator shows the relationship between the cost of solar energy and the support price, highlighting financial support relative to the cost of production;
- Renewable energy support for wind: This strategy aims to promote renewable wind energy through auctions or FITs, offering stable prices. The indicator assesses financial support against the cost of wind power production, encouraging the use of this clean energy source.

2.6. Literature Gap & Research Question

The analysis of the literature shows that the authors of the papers cited above have made little consideration of how sustainability affects investments by Venture Capital (IVC, CVC, GVC) and in particular the authors do not consider the effect of government policies (in this case *Certificates*) on these types of investments.

To achieve the goals of the thesis, one research questions was defined as follow:

RQ) What is the role of sustainability and Certificates in Venture Investments (IVC, CVC and GVC)?

In this study, through a careful methodology, which will lead to the preparation of the sample for analysis, due analysis will be carried out with the aim of filling this gap and provide a clearer picture. Sustainability and international policies are expected to have an influence on the decisions of these three types of investors.

3. METHODOLOGY

This chapter discusses the development of the database used for the study, obtained through collaboration with other students and based on data from Crunchbase. It was created by aggregating two separate datasets, analyzed separately to isolate variables relevant to the research.

3.1. Previous datasets before the aggregation

The data in the first dataset come from research conducted by previous master student students in the Department of Management Engineering at the University of Palermo. With 3715 startups and as many as 31774 observations ranging from 2010 to 2022, this first dataset includes the collection of startups we were interested in and later evaluated for our study. The 49 variables within it contain a lot of information about startups and describe the connections between them and the investments made in them.

In this case, the variables in this first dataset were: *Organization Name, Year, SUST, Headquarter location, Annex I, Estimated Revenue Range, IPO 0-1, Founded Date, Age, Rounds, Number of Founders, Size, Number of Lead Investors, Number of Investors, Money Raised, Acquisition Price, IPO Money Raised, Patents granted, IPO, M&A, Grant, Seed, Early Stage Venture, Venture Round, Late Stage Venture, Corporate Round, Other Investments, Green Climate Fund, Least Developed Countries Funds, Doha Amendment, Stand Emissions Offset Instrument, Framework REDDplus, Mechanism Loss&Damage, Review Financial Mechanism, Paris Agreement, GHG Reduction Threshold, Perc. GHG Reduction Threshold, GHG gases to be reported, n. GHG gases, N Partecipants COP, Cumulated PIL per partecipants countries, Perc. participants GDP, COVID-19, lnmoneyraised, lnacquisitionprice, lnipomoney, lncumulatepil, lnpatentsgranted*.

Then we hid 20 control variables, which were not needed for our study, so that we obtained a dataset with 29 variables (the remaining ones will be shown later). In order to obtain the country where all startups were born, a dummy variable was added for each country, a total of 33 new dummy variables, taking the value 1 when the country corresponded to the headquarters of the startup under consideration, 0 vice versa.

The second dataset is derived from the OECD database and focuses on the Environmental Policy Stringency Index (EPS) and its subcategories. The data cover the period from 1990 to

2020, but our analysis focuses on the years from 2010 onward, excluding 2021-2022 due to lack of policy data in those years.

Then an excel document was created containing this data, in this case the dataset consisted of 13 sheets for the respective sub-indices concerning the policies, namely: *CO2 Trading Scheme, Renewable Energy Trading Scheme, CO2 Tax, Nox Tax, SOx Tax, Diesel Tax, Emission limit value Nox, Emission limit value SOx, Emission limit value PM, Emission limit value sulphur, Low-carbon R&D expenditures, Wind Energy support and Solar Energy support*. Hereafter, we considered only the 13 policy indices.

3.2. The final Dataset

We integrated the two datasets, adding columns to the first dataset based on startup locations and matching them to countries in the second dataset. This allowed us to cover various aspects, such as CO2 policies and solar energy incentives. We excluded countries not in the control variables to simplify the analysis.

3.2.1. Data collection

In this part, we were concerned with better defining qualitatively, and subsequently quantitatively, the main investor groups of interest in this study, namely Independent Venture Capital (IVC), Corporate Venture Capital (CVC), Government Venture Capital (GVC), and a group of investors defined as "Other," subsequently not considered for the analysis on Stata.

In the "Other" category we mainly find 9 types of investors, namely, Private Equity Firm, Angels, Accelerator, Incubator, Angel Group, Investment Bank, Hedge Fund, Venture Debt, Government Office.

Then 14 new variables were added to the dataset, corresponding to 14 columns:

-2 variables are *Name of Lead Investors* and *Top 5 Investors*. These two new variables report the name of the investor (lead or top 5) in the given startup for a given year, and data present on these two columns go back from previous work by other students at the University of Palermo;

- 3 variables correspond to the category of investors of interest in our thesis, namely *IVC, CVC* and *GVC*;
- 9 variables each correspond to one of the categories of investors discussed earlier, which will later be contained in the macro category named *Other*.

We used the columns "Name of Principal Investors" and "Top 5 Investors" to identify the type of investor for each startup. Using the Crunchbase database, we obtained valuable information and improved our observations. To speed up the process, we split the startups in the database and removed observations without data in the above columns.

Once this was completed, 6 variables were added: 5 moderation variables corresponding to the macro-indices, namely *Certificates*, *Taxes, Performance standards, Upstream Support* and *Adoption Support*, and one variable corresponding to the *EPS* index.
These variables were added with a calculation on excel based on the sub-indexes, in this case:

$$Certificates = \frac{\text{CO2 Trading Scheme+ Renewable Energy Trading Scheme}}{2} \quad (1)$$

$$Taxes = \frac{\text{CO2 Tax+Nox Tax+SOx Tax+Diesel Tax}}{4} \quad (2)$$

$$Performance\ standards = \frac{\text{ELV NOx+ ELV SOx+ ELV Sulphur+ ELV PM}}{4} \quad (3)$$

$$Upstream\ Support = \text{Low carbon R\&D expenditures} \quad (4)$$

$$Adoption\ Support = \frac{\text{Wind Energy support+Solar Energy support}}{2} \quad (5)$$

Then we calculated the *EPS* index by summing the previous 5 moderation variables multiplied by their own weights (Kruse et al., 2022).

$$EPS = Certificates * 0{,}11 + \text{Taxes} * 0{,}22 + \text{Performance Standards} * 0{,}33 + \\ + \text{Upstream Support} * 0{,}166 + \text{Adoption Support} * 0{,}166 \quad (6)$$

3.2.2. Sample selection

Once we obtained a dataset containing 3715 startups, 31774 observations, and 54 variables, this was filtered to optimize the dataset for our study: since our interest focuses on all startups that received at least one investment from the three categories IVC, CVC, or GVC, we did not consider all those startups that did not have this requirement, and consequently the variable Other, which contained the other types of investors, was not considered either. So we created 3 new Dependent variables, called *NIVC, NCVC,* and *NGVC*, containing precisely the total number, for each startup corresponding to a given year, of investments from these 3 types of investors.

Then, as mentioned above, the country-related control variables were grouped into 5 macro geographical areas, called *OECD, USA, Europe, Asia* and *Other*. In addition, all those moderating variables that were no longer needed were removed, namely the 13 sub-indices of EPS, as these are now grouped into the 5 macro-indices namely *Certificates, Taxes, Performance standards, Upstream Support* and *Adoption Support.*

The 5 macro indices are of key importance to our research, as each student was assigned a different macro index to be analyzed using the Stata Software to investigate the moderating role of these indexes for the 3 types of investors we are analyzing in this study. For my study I analyze the variable *Certificates*.

At this point the team decided to exclude other control variables that were not particularly useful for our analysis. Since STATA reads only numbers, we cleaned the dataset of all those variables containing strings, such as the one containing the name of startups or the head quarter location.

Thus, after eliminating 33 control variables (related to countries), 13 moderating variables (related to sub-indices), some motherator variables that are not anymore useful for our data research (Organization name and head quarter locationand) all observations that were not useful for our STATA analysis, we came out with a greatly reduced dataset with 368 startups, 722 observations, and 25 variables.

The next part will describe the 30 variables found within the final dataset. In the present case we have:

- 3 Dependent variables, namely *NIVC, NCVC, NGVC*;
- An Independent variable, namely *SUST*
- A moderating variables, namely *Certificates;*
- 20 control variables, namely Year, *OECD, USA, Europe, Asia, Other, Age, Rounds, Number of Founders, Size, M&A, Grant, Seed, Early Stage Venture, Venture Round, Late Stage Venture, Corporate Round, Other Investments, lnmoneyraised, lnpatentgranted.*

3.2.3. Dependent variables

We have seen how essential it is to have access to external expertise to improve an organization's innovation process. Companies can use external resources to create sustainable innovations through partnerships, investments in startups, M&A, shared R&D, crowdsourcing, and other strategies (Makri et al., 2010).

In the present case, one form of accessing these external resources to innovate on the topic of sustainability, in line with the global direction on the same, are Venture Capital programs (Bocken, 2015).

The objective of this study is to investigate how sustainability, and in particular international policies, can influence the likelihood of investment in startups by three main categories of venture capital, namely Independent Venture Capital (IVC), Corporate Venture Capital (CVC), and Government Venture Capital (GVC). So the dependent variables in this study are the number of these types of investors (NIVC, NCVC e NGVC).

These are all three Count variables that take a value based on the number of venture capital firms that invested in a startup in a given year.

3.2.4. Indipendent variable

More and more businesses are taking into account how their operations affect the environment, society, and economy as a result of environmental, social, and economic concerns. In addition Consumers expect companies to act responsibly and sustainably, and startups that embrace this philosophy can enjoy a significant competitive advantage (Bending, 2022). Regulatory changes push companies to be more sustainability conscious (Bianchini, 2022).

In such a context, the study focuses on understanding whether indeed startups that demonstrate a sustainable vision and a more responsible approach to the planet are becoming more attractive to venture capital investors. Consequently, our only independent variable will be sustainability, defined as *SUST*; this is a win-win variable that takes value 1 if the startup is sustainable, 0 vice versa.

3.2.5. Moderator variable: *Certificates*

In this study, we analyze the macro-index related to Certificates, which acts as the moderator variable. We aim to determine if government policies in this area attract investments from IVCs, CVCs, and GVCs, with a focus on their impact on sustainability. This variable includes two sub-indices: CO2 Trading Scheme and Renewable Energy Trading Scheme.

The CO2 Trading Scheme, known as Carbon Trading, is a market-based climate change mitigation strategy. Main purpose: to reduce CO2 and greenhouse gas emissions. The government sets emission limits for industrial sectors, allocating emission allowances to participants such as industrial plants and power plants. These allowances can be traded, creating

a market for CO2 emissions (Botta & Koźluk, 2014; D. Hegeman & Sørheim, 2021; Kruse et al., 2022).

The Renewable Energy Trading Scheme is similar to the CO2 Trading Scheme but focuses on promoting renewable energy production and consumption. This system manages renewable energy certificates, which can be traded among participants to support green energy. Companies can obtain new certificates to support renewable energy production. Trading can take place nationally or internationally, depending on countries' policies (Botta & Koźluk, 2014; Kruse et al., 2022). These two indices were aggregated into the *Certificates* variable, via the formula already explained in the Final Dataset section:

$$Certificates = \frac{\text{CO2 Trading Scheme+ Renewable Energy Trading Scheme}}{2} \qquad (7)$$

This variable is continuous and can range from 0 to 6, representing from the least rigorous to the most rigorous observation, like the other indices in the EPS. This choice was made to standardize the scale of measurement of different environmental policies, allowing the creation of a composite index (the EPS). Ranges from 0 to 6 are assigned based on the distribution of observations, with zero assigned to situations where no policy is present. The other scores gradually reflect greater rigidity of environmental policies (Kruse et al., 2022).

3.2.6. Control Variables

Control variables were added based on both the literature and the needs of our research. For example, the first variable we worked with was country, as each country has a different level of political stringency. Accordingly, starting from the head quarter location, we obtained 5 macro control variables: *OECD, USA, Europe, Asia and other*. These dummy variables take value 1 if the startup is based in the country of the corresponding variable, 0 otherwise (Battisti et al., 2022; Bianchini & Croce, 2022; De Lange, 2019).

In addition, the variable *Age* was created to indicate the year of the startup, which has a range from 1 to 13 (De Lange, 2019). Then there is the *Year* variable which indicates the year in which the investment took place and takes on integer values in a range from 2010 to 2022.

The categorical variable *Size* considers the "size" of the startup, denoted as the number of workers the startup has under contract. The range of this variable is from 1 to 8, and the values that can assume are defined on Table 1 (Battisti et al., 2022; De Lange, 2019).

The variable count *Number of Founders* was added because according to some of Mrkajic's studies, the larger the team of founders the more likely an investment on the startup in question. The range is from 1 to 7 (Boris Mrkajic, 2019).

Other control variables that give indications of the type of investments made in the past on startups are the count *Rounds* variable and the continuous *Money Raised* variable (De Lange, 2019).

Patent Granted is an important variable because it could influence whether or not investments were made in startups. It is a count variable that indicates the number of patents held by startups (Boris Mrkajic, 2019; Carmen Cotei & Joseph Farhat, 2018).

To give further information about the type of investments and the mode of them, 7 dummy variables were added, which take value 1 if the startup received that particular type of investment in a given year, 0 vice versa: *Grant, Seed, Early-Stage Venture, Venture round, Late-Stage Venture, Corporate Round*, and *Other Investment* (D. Hegeman & Sørheim, 2021).

The variable "Grant" indicates whether the company has received non-repayable funding, usually from government agencies or philanthropic organizations, to support the early stage of a startup without requiring equity or equity participation from investors. *Seed* is a variable that indicates whether the type of investment was received during the seed stage, which is one of the earliest stages of a startup's development, in which researching and obtaining funding to start the business is very important. Investors in this stage get a stake in the company.

Early stage venture is an investment that aims to support the company while it is still high risk, with the aim of requiring a significant share of equity. It is a type of investment that occurs after the seed stage.

Venture round is a type of investment that often occurs in the growth or expansion stage: the startup seeks funding from outside investors in order to expand the company, access important resources and partnerships, improve product distribution, and enhance strategic advantage. The dummy variable *Late Stage* Venture represents late stage investment, which is when the startup is solid and well established and has already demonstrated success. With this type of investment, an attempt is made to support the company in its further growth.

The *corporate round* occurs when an established company, usually a large corporation, invests in the startup. In this case, the benefits to the startup are multiple, such as access to innovation resources, partnerships, distributions, and strategic advantages (Colombo & Murtinu, 2015).

Finally, the variable *Other Investments* covers all types of investments other than those previously explained, which were merged into a single variable because they were small in number in our sample. Financial Debt, Secondary Market, Equity Post-IPO, and Equity Crowdfunding are some examples that fall into this category.

The dummy *M&A* variable is very important because investors see it as an effective way to combine the know-how, resources, and innovation of two companies. These acquisitions often involve a large outlay of money to purchase high-potential startups. Here the variable takes value 1 if the startup was acquired in that year, 0 vice versa (Carmen Cotei & Joseph Farhat, 2018).

Table 3.1 summarizes all the variables used for the study, with the name, type, description and, where possible, the references from which they were taken.

VARIABLE	VARIABLE NAME	TYPE	DESCRIPTION	REFERENCE
DEPENDENT VARIABLE	*NIVC*	Count	Defined in a range from 1 to 5	Bianchini&Croce, 2022
DEPENDENT VARIABLE	*NCVC*	Count	Defined in a range from 1 to 4	Bending et al., 2022
DEPENDENT VARIABLE	*NGVC*	Count	Defined in a range from 1 to 3	Bianchini&Croce, 2022
INDIPENDENT VARIABLE	*Sustainability*	Dummy	1 if the startup is sustainable 0 otherwise	deLange&Valiere, 2019
MODERATOR VARIABLE	*Certificates*	Continuous	Defined in a range from 0 to 6	Bianchini&Croce, 2022; Cojoianu et al., 2020
CONTROL VARIABLE	*Year*	Integer	Defined in a range from 2010 to 2022	---
CONTROL VARIABLE	*OECD*	Dummy	1 if the startup is located in an OECD country 0 otherwise	Bianchini&Croce, 2022
CONTROL VARIABLE	*USA*	Dummy	1 if the startup is located in USA 0 otherwise	deLange, 2017
CONTROL VARIABLE	*Europe*	Dummy	1 if the startup is located in Europe 0 otherwise	deLange, 2017; Battisti, 2022
CONTROL VARIABLE	*Asia*	Dummy	1 if the startup is located in Asia 0 otherwise	deLange, 2017
CONTROL VARIABLE	*Other*	Dummy	1 if the startup is located in other country 0 otherwise	Battisti, 2022; Bianchini&Croce, 2022
CONTROL VARIABLE	*Age*	Count	Defined in a range from 1 to 13	deLange&Valiere, 2019
CONTROL VARIABLE	*Rounds*	Count	Defined in a range from 0 to 8	deLange&Valiere, 2019
CONTROL VARIABLE	*N. of Founders*	Count	Defined in a range from 1 to 7	Mrkajic, 2019

CONTROL VARIABLE	*Size*	Count	1 if 1-10 2 if 11-50 3 if 51-100 4 if 101-250 5 if 251-500 6 if 501-1000 7 if 1001-5000 8 if 5001-10000 9 if 10001+	deLange&Valiere, 2019; Battisti, 2022; Cotei, 2018
CONTROL VARIABLE	*M&A*	Dummy	1 if the sturtup is been acquired 0 otherwise	De Lange&Valiere, 2019
CONTROL VARIABLE	*Grant*	Dummy	1 if an investment during Grant Stage is received 0 otherwise	Hegeman&Sørheim, 2021
CONTROL VARIABLE	*Seed*	Dummy	1 if an investment during Seed Stage is received 0 otherwise	De Lange and Valiere, 2019
CONTROL VARIABLE	*Early Stage Venture*	Dummy	1 if an investment during Early Stage is received 0 otherwise	---
CONTROL VARIABLE	*Venture round*	Dummy	1 if an investment during Venture Stage is received 0 otherwise	Hegeman&Sørheim, 2021; De Lange and Valiere, 2019
CONTROL VARIABLE	*Late Stage Venture*	Dummy	1 if an investment during Late Stage is received 0 otherwise	---
CONTROL VARIABLE	*Corporate Round*	Dummy	1 if an investment during Corporate Round Stage is received 0 otherwise	Hegeman&Sørheim, 2021; deLange and Valiere, 2019
CONTROL VARIABLE	*Other Investments*	Dummy	1 if other investments are received 0 otherwise	---
CONTROL VARIABLE	*Lnmoneyraised*	Continuous	Defined in a range from 0 to 21.126	De Lange and Valiere, 2019
CONTROL VARIABLE	*Lnpatentgranted*	Count	Defined in a range from 0 to 6524	Boris Mrkajic & Al., 2019; Cotei, 2018

Table 3.1 Control Variables

4. ANALYSIS

This chapter focuses in the results obtained through the analysis. In order to perform the statistical analysis on the collected data, it has been decided to use the software STATA. This software represents an excellent compromise for the user because of the ease of use and the wide range of statistical tools for analysis, as well as the computing power for the latter.

4.1. Descriptive statistics analysis

The first step was to analyze the descriptive statistics (Table 3) of our dataset using the *summarize* command, in order to obtain a quick and informative overview of the main characteristics of the variables, such as mean, median, standard deviation, variance, number of observations, and maximum and minimum value.

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Year	722	2017.367	3.139	2010	2022
SUST	722	0.084	0.278	0	1
OECD	721	0.775	0.418	0	1
USA	721	0.458	0.499	0	1
EUROPE	721	0.243	0.429	0	1
ASIA	721	0.19	0.393	0	1
OTHER	721	0.11	0.313	0	1
Age	722	4.035	2.491	1	13
N rounds	722	1.201	0.68	0	7
NumberofFounders	670	2.258	1.239	1	7
Size	712	2.545	1.574	1	8
NIVC	722	1.867	1.713	0	14
NCVC	722	0.166	0.459	0	4
NGVC	722	0.116	0.346	0	2
M&A	722	0.01	0.098	0	1
Grant	722	0.05	0.218	0	1
Seed	722	0.325	0.469	0	1
EarlyStageVenture	722	0.271	0.445	0	1
VentureRound	722	0.12	0.326	0	1
LateStageVenture	722	0.046	0.209	0	1
CorporateRound	722	0.019	0.138	0	1
OtherInvestments	722	0.093	0.29	0	1
lnmoneyraised	569	13.775	4.593	0	21.126
lnpatentsgranted	722	0.542	1.168	0	6.524
Certificates	551	1.833	1.157	0	4.5

Table 4.1 Desctiptive analysis

This graph shows that the mean and variance for the three dependent variables (*NIVC, NCVC,* and *NGVC)* under analysis are close to each other, making it possible to use both Poisson and Negative Binomial regression. As a result, the goodness-of-fit chi-squared test will be performed for each dependent variable on the Econometric Analysis paragraph, using the commang *estat gof.*

The 171 missing observations for the moderation variable *Certificates* are due to missing values for the years 2021 and 2022, as mentioned in Chapter 3.1. Consequently, this small gap does not represent a critical issue for the study.

4.2. Pairwise correlation analysis

A correlation analysis was conducted, to explore the relationships between the variables and identify potential relationships and to confirm that the variables do not have a high correlation before performing the analysis. Table 4 shows the correlation between the variables in this study. The threshold is set at 0.7 to avoid potential multicollinearity problems in the data. In addition, the table is used to have more stability in the model.

The results of table 4 show that only the *OECD* and *ASIA* variables have a high correlation value (0.671). Since this is a borderline correlation, but not greater than or equal to 0.7, neither variable will be excluded from the model, but we will keep this result in mind.

Out of 24 total variables, only two reached a level of correlation at the borderline of criticality: this result represents the independence and goodness-of-fit of the other variables within the dataset, and consequently of future analyses of VC investments.

Moreover, the *OTHER* variable is excluded from the analysis, as having operationalized the startup headquarters with a set of dummy variables, one of the variables must be eliminated to use it as a baseline.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Year	1.000													
(2) SUST	-0.051	1.000												
	(0.168)													
(3) OECD	-0.029	0.128*	1.000											
	(0.437)	(0.001)												
(4) USA	-0.039	0.061	0.495*	1.000										
	(0.301)	(0.103)	(0.000)											
(5) EUROPE	0.022	0.026	0.282*	-0.520*	1.000									
	(0.549)	(0.494)	(0.000)	(0.000)										
(6) ASIA	0.000	-0.109*	-0.671*	-0.445*	-0.274*	1.000								
	(0.990)	(0.003)	(0.000)	(0.000)	(0.000)									
(7) OTHER	0.030	0.005	-0.332*	-0.322*	-0.199*	-0.170*	1.000							
	(0.417)	(0.892)	(0.000)	(0.000)	(0.000)	(0.000)								
(8) Age	0.590*	0.076*	0.029	0.038	-0.033	-0.028	0.019	1.000						
	(0.000)	(0.042)	(0.436)	(0.302)	(0.381)	(0.446)	(0.609)							
(9)N_rounds	0.099*	0.005	0.008	0.019	-0.001	0.018	-0.051	0.051	1.000					
	(0.008)	(0.883)	(0.836)	(0.611)	(0.980)	(0.631)	(0.167)	(0.173)						
(10)NumberofFounders	0.093*	0.032	0.056	0.090*	0.013	-0.082*	-0.063	0.053	0.068	1.000				
	(0.016)	(0.413)	(0.147)	(0.020)	(0.736)	(0.033)	(0.102)	(0.172)	(0.079)					
(11) Size	0.070	-0.029	-0.207*	-0.004	-0.154*	0.110*	0.082*	0.153*	0.095*	0.258*	1.000			
	(0.063)	(0.432)	(0.000)	(0.924)	(0.000)	(0.003)	(0.029)	(0.000)	(0.011)	(0.000)				
(12) NIVC	0.092*	-0.052	0.081*	0.207*	-0.151*	-0.101*	0.004	-0.008	0.192*	0.149*	0.251*	1.000		
	(0.013)	(0.162)	(0.030)	(0.000)	(0.000)	(0.007)	(0.922)	(0.830)	(0.000)	(0.000)	(0.000)			
(13) NCVC	0.093*	0.031	0.050	0.079*	-0.057	-0.006	-0.040	0.115*	0.071	0.091*	0.135*	0.093*	1.000	
	(0.012)	(0.405)	(0.177)	(0.033)	(0.125)	(0.869)	(0.282)	(0.002)	(0.058)	(0.019)	(0.000)	(0.012)		
(14) NGVC	-0.036	0.229*	0.085*	-0.028	0.099*	-0.112*	0.049	0.040	0.095*	0.057	-0.112*	-0.175*	-0.061	1.000
	(0.340)	(0.000)	(0.022)	(0.457)	(0.008)	(0.003)	(0.191)	(0.278)	(0.011)	(0.138)	(0.003)	(0.000)	(0.103)	
(15) MA	-0.016	-0.030	0.053	0.023	0.043	-0.048	-0.035	0.044	-0.071	0.014	0.011	-0.009	0.026	0.048
	(0.666)	(0.420)	(0.153)	(0.545)	(0.250)	(0.198)	(0.352)	(0.237)	(0.057)	(0.715)	(0.775)	(0.813)	(0.489)	(0.193)
(16) Grant	0.008	0.159*	0.108*	0.007	0.108*	-0.095*	-0.040	0.053	-0.012	0.042	-0.141*	-0.213*	-0.055	0.457*
	(0.837)	(0.000)	(0.004)	(0.858)	(0.004)	(0.011)	(0.288)	(0.154)	(0.758)	(0.274)	(0.000)	(0.000)	(0.138)	(0.000)
(17) Seed	-0.145*	-0.052	-0.024	-0.054	0.057	0.019	-0.016	-0.361*	-0.036	-0.066	-0.222*	-0.039	-0.155*	-0.097*
	(0.000)	(0.166)	(0.515)	(0.147)	(0.128)	(0.608)	(0.677)	(0.000)	(0.339)	(0.088)	(0.000)	(0.292)	(0.000)	(0.009)
(18)EarlyStageVenture	0.064	-0.017	-0.037	0.096*	-0.113*	0.030	-0.035	0.117*	0.026	0.067	0.169*	0.193*	0.003	-0.088*
	(0.088)	(0.639)	(0.320)	(0.010)	(0.002)	(0.423)	(0.352)	(0.002)	(0.489)	(0.083)	(0.000)	(0.000)	(0.939)	(0.018)
(19)VentureRound	0.058	-0.067	0.036	-0.092*	0.088*	0.016	0.006	0.156*	0.041	-0.048	-0.037	-0.086*	-0.004	-0.026
	(0.117)	(0.074)	(0.332)	(0.013)	(0.018)	(0.669)	(0.864)	(0.000)	(0.273)	(0.210)	(0.328)	(0.021)	(0.909)	(0.483)
(20)LateStageVenture	0.103*	-0.066	-0.041	0.065	-0.078*	0.029	-0.034	0.194*	0.023	0.115*	0.314*	0.114*	0.195*	-0.054
	(0.005)	(0.074)	(0.270)	(0.080)	(0.037)	(0.433)	(0.357)	(0.000)	(0.535)	(0.003)	(0.000)	(0.002)	(0.000)	(0.144)

Variables (1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14)

(21)CorporateRound	0.080*	-0.007	-0.045	-0.069	-0.033	0.162*	-0.049	0.083*	0.047	0.014	0.035	-0.095*	0.277*	-0.047
	(0.032)	(0.859)	(0.231)	(0.065)	(0.379)	(0.000)	(0.186)	(0.026)	(0.206)	(0.710)	(0.358)	(0.011)	(0.000)	(0.204)
(22)OtherInvestments	0.069	0.074*	0.035	0.032	-0.036	-0.058	0.071	0.120*	0.327*	-0.018	0.083*	-0.009	0.040	-0.011
	(0.064)	(0.045)	(0.349)	(0.391)	(0.330)	(0.122)	(0.056)	(0.001)	(0.000)	(0.649)	(0.026)	(0.817)	(0.281)	(0.768)
(23)lnmoneyraised	0.300*	-0.066	0.046	0.096*	-0.066	0.001	-0.065	0.311*	0.509*	0.172*	0.270*	0.200*	0.130*	-0.087*
	(0.000)	(0.117)	(0.273)	(0.023)	(0.115)	(0.976)	(0.121)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.038)
(24)lnpatentsgranted	0.006	0.058	0.239*	0.227*	-0.127*	-0.106*	-0.054	0.169*	-0.033	0.032	0.253*	0.016	0.205*	0.028
	(0.864)	(0.121)	(0.000)	(0.000)	(0.001)	(0.004)	(0.145)	(0.000)	(0.381)	(0.406)	(0.000)	(0.668)	(0.000)	(0.454)
(25)Certificates	0.180*	0.027	0.449*	0.549*	-0.010	-0.550*	-0.224*	0.054	0.051	0.040	-0.022	0.101*	0.027	-0.070
	(0.000)	(0.523)	(0.000)	(0.000)	(0.822)	(0.000)	(0.000)	(0.209)	(0.232)	(0.366)	(0.614)	(0.017)	(0.522)	(0.100)
Variables	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)			
(15) MA	1.000													
(16) Grant	-0.023	1.000												
	(0.543)													
(17) Seed	-0.039	-0.159*	1.000											
	(0.301)	(0.000)												
(18)EarlyStageVenture	0.003	-0.140*	-0.424*	1.000										
	(0.932)	(0.000)	(0.000)											
(19)VentureRound	0.050	-0.085*	-0.257*	-0.226*	1.000									
	(0.178)	(0.023)	(0.000)	(0.000)										
(20)LateStageVenture	-0.022	-0.050	-0.152*	-0.134*	-0.081*	1.000								
	(0.561)	(0.178)	(0.000)	(0.000)	(0.030)									
(21)CorporateRound	-0.014	-0.032	-0.098*	-0.086*	-0.052	-0.031	1.000							
	(0.709)	(0.387)	(0.009)	(0.021)	(0.162)	(0.409)								
(22)OtherInvestments	-0.032	-0.073*	-0.222*	-0.195*	-0.118*	-0.070	-0.045	1.000						
	(0.396)	(0.049)	(0.000)	(0.000)	(0.001)	(0.060)	(0.227)							
(23)lnmoneyraised	-0.092*	-0.059	-0.028	0.316*	0.078	0.182*	0.070	0.138*	1.000					
	(0.029)	(0.159)	(0.498)	(0.000)	(0.061)	(0.000)	(0.093)	(0.001)						
(24)lnpatentsgranted	-0.024	0.021	-0.190*	0.063	0.004	0.204*	0.073	0.014	0.114*	1.000				
	(0.516)	(0.580)	(0.000)	(0.089)	(0.921)	(0.000)	(0.050)	(0.704)	(0.007)					
(25)Certificates	0.000	0.027	0.014	0.000	-0.044	0.027	-0.105*	0.058	0.098*	0.104*	1.000			
	(0.999)	(0.527)	(0.744)	(0.992)	(0.301)	(0.527)	(0.013)	(0.176)	(0.040)	(0.015)				

**** p<0.01, ** p<0.05, * p<0.1*

Table 4.2 Pairwise correlation matrix

4.3. Econometric analysis

In this chapter, three regressions will be run for each individual dependent variable (NIVC, NCVC and NGVC):

- In the first regression is consider the dependent variable and the control variables, in order to understand how the control variables chosen for that type of regression affect the dependent variable;
- In the second regression, the independent variable SUST is added to test the main dependence, which is how sustainability affects the number of VCs;
- In the third regression is included the product between the SUST variable and the standardized moderator variable *Certificates*. This important regression gives us information on how the effect of Sustainability on the number of Venture Capital investors can vary with the variation of *Certificates*.

Since the three dependent variables are Count, we will proceed to verify which regression model to use for this study. From the descriptive analysis in Chapter 4.1, the unconditional mean of our outcome variables are almost equal to their variance.
To better understand if Poisson model fit, it was decided to perform the goodness-of-fit chi-squared test on all three dependent variable regressions, as in the example in Figure 4.

```
. estat gof

        Deviance goodness-of-fit =  688.6636
        Prob > chi2(557)         =    0.0001

        Pearson goodness-of-fit  =  719.6281
        Prob > chi2(557)         =    0.0000
```

Figure 4.2. goodness-of-fit chi-squared test per gli IVC

As a result of the tests, it was possible to definitively discard the Poisson model fit because most of the tests were significant, so it was decided to use the negative Binomial regression model, since it can be considered as a generalization of Poisson regression. This type of regression can be used for over-dispersed count data.

4.3.1. IVC analysis

As mentioned before, in the first model the dependent variable Numbers of IVC will be regressed considering only the control variables. The command used for the regressions that follow is "nbreg."

The following table shows the first regression for the dependent variable *NIVC*:

Negative binomial regression

NIVC	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
OECD	.372	.16	2.32	.021	.057	.686	**
USA	.007	.14	0.05	.958	-.267	.282	
EUROPE	-.445	.154	-2.89	.004	-.747	-.143	***
ASIA	-.137	.145	-0.94	.346	-.422	.148	
Age	-.019	.016	-1.15	.25	-.05	.013	
N_rounds	.152	.049	3.09	.002	.056	.248	***
NumberofFounders	.036	.029	1.26	.209	-.02	.092	
Size	.115	.025	4.54	0	.065	.165	***
MA	.08	.354	0.22	.822	-.615	.774	
Seed	.299	.165	1.81	.07	-.024	.623	*
EarlyStageVenture	.469	.179	2.62	.009	.118	.82	***
VentureRound	.15	.197	0.76	.444	-.235	.536	
LateStageVenture	.411	.224	1.83	.067	-.028	.85	*
CorporateRound	-.521	.432	-1.21	.227	-1.368	.325	
OtherInvestments	.101	.208	0.48	.628	-.307	.509	
lnmoneyraised	-.004	.014	-0.27	.785	-.03	.023	
lnpatentsgranted	-.09	.031	-2.85	.004	-.151	-.028	***
Constant	-.161	.186	-0.87	.386	-.526	.203	
Constant	-2.325	.318	.b	.b	-2.948	-1.701	

Mean dependent var	2.116	SD dependent var	1.862
Pseudo r-squared	0.063	Number of obs	533
Chi-square	123.589	Prob > chi2	0.000
Akaike crit. (AIC)	1870.110	Bayesian crit. (BIC)	1951.402

*** p<.01, ** p<.05, * p<.1

Table 3.4 NIVC, only control variables

What emerges from the first model is that startups that are based in the *OECD* territories (p-value of 0.021) are more likely to receive investment from IVCs. The startups base in EUROPE have a negative impact on receiving investments by IVC (p-value of 0.004) while those born in *USA* and *ASIA* territories are not a particular interest to this type of investor. The *Number of Rounds* and *Size* (both with a p-value = 0) of startups positively affect IVC investments, while the Age, *Total Money Raised* and the *Number of Founders* of the startups does not seem to interest these investors.

The impact of the investment types *Seed*, *EarlystageVenture and Latestage venture* is significant and positive (respective p-values of 0.07, 0.009 and 0.067). We expected this result because they represent the most common types of investments for IVCs (Wang, 2022).

The *VentureRound, Corporate Round*, and *Other investment* phases are not of particular interest to IVCs, as well as the variable *M&A*.

These investors are negatively affected by the number of *patents granted* (p-value 0.004).

In the second regression we add the independent variable Sustainability (*SUST*) in order to analyze its direct interaction with IVC investors.

The following table shows the second regression for the dependent variable *NIVC*:

Negative binomial regression

NIVC	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SUST	-.232	.127	-1.82	.068	-.48	.017	*
OECD	.397	.16	2.48	.013	.084	.711	**
USA	-.002	.14	-0.01	.99	-.276	.272	
EUROPE	-.461	.154	-2.99	.003	-.762	-.159	***
ASIA	-.143	.145	-0.99	.323	-.426	.141	
Age	-.015	.016	-0.90	.366	-.047	.017	
N_rounds	.155	.049	3.17	.002	.059	.251	***
NumberofFounders	.036	.028	1.27	.204	-.02	.092	
Size	.117	.025	4.63	0	.067	.167	***
MA	.051	.353	0.15	.884	-.64	.743	
Seed	.273	.165	1.65	.099	-.051	.596	*
EarlyStageVenture	.431	.179	2.40	.016	.08	.783	**
VentureRound	.105	.197	0.53	.596	-.282	.491	
LateStageVenture	.349	.226	1.55	.122	-.093	.792	
CorporateRound	-.557	.431	-1.29	.197	-1.402	.289	
OtherInvestments	.074	.208	0.36	.721	-.334	.482	
lnmoneyraised	-.004	.013	-0.29	.774	-.03	.023	
lnpatentsgranted	-.088	.031	-2.83	.005	-.149	-.027	***
Constant	-.147	.185	-0.79	.428	-.51	.216	
Constant	-2.375	.332	.b	.b	-3.026	-1.723	

Mean dependent var	2.116	SD dependent var	1.862
Pseudo r-squared	0.065	Number of obs	533
Chi-square	127.028	Prob > chi2	0.000
Akaike crit. (AIC)	1868.671	Bayesian crit. (BIC)	1954.241

*** p<.01, ** p<.05, * p<.1

Table 4.4 NIVC, control variables and SUST

Analyzing Table 6, we see that the situation of the control variables is almost unchanged, except for *Late Stage Venture*, which lose significance. The variable *Sustainability* has a small negative impact, with a significant p-value of 0.068. Thus, in the presence of sustainable startups IVCs invest less. This interesting result may come from the fact that this type of investor is usually

interested in a short-term return on investment, while sustainability is a long-term goal of Startups (Colombo & Murtinu, 2015; Hockerts & Wüstenhagen, 2010).

In the last regression the moderator variable *Certificates* is included, to analyze its interaction with the independent variable Sustainability.

The following table shows the first third regression for the dependent variable *NIVC*:

Negative binomial regression

NIVC	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SUST	-.726	.377	-1.93	.054	-1.464	.012	*
Certificates	.011	.056	0.19	.849	-.098	.12	
SUST#Certificates	.248	.171	1.46	.145	-.086	.583	
OECD	.662	.189	3.50	0	.291	1.033	***
USA	-.2	.174	-1.16	.248	-.541	.14	
EUROPE	-.706	.176	-4.01	0	-1.05	-.361	***
ASIA	-.037	.177	-0.21	.833	-.384	.309	
Age	-.032	.021	-1.51	.13	-.073	.009	
N_rounds	.124	.06	2.08	.038	.007	.242	**
NumberofFounders	.025	.033	0.76	.449	-.04	.09	
Size	.138	.03	4.66	0	.08	.196	***
MA	.299	.347	0.86	.389	-.381	.979	
Seed	.269	.178	1.51	.13	-.079	.617	
EarlyStageVenture	.313	.197	1.59	.112	-.073	.7	
VentureRound	.185	.222	0.84	.404	-.249	.619	
LateStageVenture	.368	.252	1.46	.143	-.125	.861	
CorporateRound	-.624	.502	-1.24	.214	-1.607	.36	
OtherInvestments	.119	.229	0.52	.603	-.33	.568	
lnmoneyraised	-.012	.015	-0.83	.407	-.041	.016	
lnpatentsgranted	-.069	.034	-2.01	.045	-.137	-.002	**
Constant	-.132	.226	-0.59	.558	-.574	.31	
Constant	-2.834	.558	.b	.b	-3.927	-1.741	

Mean dependent var	1.971	SD dependent var	1.713
Pseudo r-squared	0.067	Number of obs	413
Chi-square	97.130	Prob > chi2	0.000
Akaike crit. (AIC)	1400.187	Bayesian crit. (BIC)	1488.702

**** p<.01, ** p<.05, * p<.1*

Table 4.5, NIVC, moderating effect of Certificates

From Table 7, *Certificates* do not directly influence the investments of IVCs. Although the influence of Sustainability towards IVCs is always negative. The results obtained for this model do not show significance for the interaction between the two variables *SUST* and *Certificates*. So IVCs are not used to investing in sustainable startups, and this trend is not altered by the presence of Certificates.

4.3.2. CVC analysis

The first regression analyzed contains the dependent variable *NCVC* and the control variables selected for this study:

Negative binomial regression

NCVC	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
OECD	.153	.525	0.29	.771	-.876	1.183	
USA	.267	.502	0.53	.595	-.716	1.25	
EUROPE	-.228	.564	-0.40	.686	-1.333	.877	
ASIA	-.098	.519	-0.19	.851	-1.116	.92	
Age	-.01	.051	-0.20	.842	-.11	.089	
N_rounds	.085	.155	0.54	.586	-.22	.389	
NumberofFounders	.094	.087	1.09	.278	-.076	.264	
Size	.092	.08	1.15	.084	-.036	.249	*
MA	1.456	.767	1.90	.058	-.048	2.959	*
Seed	-.784	.574	-1.37	.043	-.078	.34	**
EarlyStageVenture	-.138	.559	-0.25	.806	-1.234	.959	
VentureRound	.14	.6	0.23	.816	-1.036	1.316	
LateStageVenture	.543	.637	0.85	.394	-.706	1.791	
CorporateRound	2.014	.656	3.07	.002	.729	3.3	***
OtherInvestments	.044	.642	0.07	.945	-1.213	1.302	
lnmoneyraised	.046	.046	0.99	.323	-.045	.136	
lnpatentsgranted	.176	.081	2.18	.029	.018	.334	**
Constant	-3.367	.671	-5.02	0	-4.683	-2.052	***
Constant	-1.705	1.636	.b	.b	-4.911	1.501	

Mean dependent var	0.176	SD dependent var	0.478
Pseudo r-squared	0.121	Number of obs	533
Chi-square	64.168	Prob > chi2	0.000
Akaike crit. (AIC)	502.802	Bayesian crit. (BIC)	584.094

*** *p<.01, ** p<.05, * p<.1*

Table 4.6 NCVC, only control variables

From Table 8, CVC investors do not seem to be influenced by the location of the startups; in fact, all region-related variables, such as *OECD, USA, EUROPE*, and *ASIA*, have no impact on CVC's decision.

The variables *Age, Number of rounds, Number of founders,* and *Money raised* do not have a significant impact on CVCs' decisions. *Size* and *M&A* variables have a slight positive impact on CVCs' investments (p-value of 0.084 and 0.058, respectively).

Regarding the type of investment, we note that *Corporate Venture Round* has a very significant positive impact on CVC investments (p-value 0.002), while in *Seed* stage of investment it seems that CVCs invest less (p-value 0.043). This could be given by the characteristics of this type of investors, which often seeks ready-made technology solutions to be incorporated into the parent

company's core business, while in the seed stage startups are not yet developed (Wadhwa et al., 2016).

The other stages of investments, such *as Early Stage Venture, Venture Round, and Other Investments*, do not affect the decisions of CVCs. Finally, the number of *Patent Granted* positively influences the investments of CVCs, again because of their peculiarity to obtain new technological sources within the parent company.

The following table shows the second regression for the dependent variable *NCVC*:

Negative binomial regression

NCVC	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SUST	.483	.338	1.43	.152	-.178	1.145	
OECD	.13	.528	0.25	.805	-.904	1.165	
USA	.306	.497	0.62	.537	-.667	1.28	
EUROPE	-.175	.561	-0.31	.756	-1.275	.925	
ASIA	-.058	.525	-0.11	.913	-1.087	.972	
Age	-.016	.051	-0.31	.757	-.116	.084	
N_rounds	.075	.156	0.48	.629	-.23	.38	
NumberofFounders	.086	.087	0.99	.322	-.085	.257	
Size	.099	.08	1.23	.092	-.058	.255	*
MA	1.53	.768	1.99	.046	.024	3.036	**
Seed	-.691	.578	-1.20	.031	-.067	.441	**
EarlyStageVenture	-.02	.565	-0.04	.971	-1.128	1.088	
VentureRound	.279	.609	0.46	.646	-.914	1.472	
LateStageVenture	.712	.648	1.10	.272	-.559	1.982	
CorporateRound	2.132	.663	3.22	.001	.833	3.43	***
OtherInvestments	.138	.641	0.21	.83	-1.119	1.394	
lnmoneyraised	.044	.046	0.96	.337	-.046	.134	
lnpatentsgranted	.179	.08	2.22	.026	.021	.336	**
Constant	-3.491	.685	-5.09	0	-4.835	-2.148	***
Constant	-1.741	1.662	.b	.b	-4.998	1.516	

Mean dependent var	0.176	SD dependent var	0.478
Pseudo r-squared	0.125	Number of obs	533
Chi-square	66.051	Prob > chi2	0.000
Akaike crit. (AIC)	502.918	Bayesian crit. (BIC)	588.489

*** p<.01, ** p<.05, * p<.1*

Table 4.7 NCVC, control variables and SUST

Examining the second regression, Sustainability is not significant (p-value 0.152). This indicates that CVC type investors do not have a particular interest in investing in sustainable startups; therefore, Sustainability cannot be considered as a driver for this type of investors.

The following table shows the second regression for the dependent variable *NCVC*:

Negative binomial regression

NCVC	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SUST	.045	1.145	0.04	.969	-2.199	2.29	

Certificates	.056	.207	0.27	.787	-.35	.462	
SUST#Certificates	.182	.509	0.36	.72	-.816	1.181	
OECD	.06	.682	0.09	.93	-1.277	1.397	
USA	.296	.7	0.42	.672	-1.076	1.669	
EUROPE	-.179	.724	-0.25	.805	-1.598	1.24	
ASIA	-.04	.692	-0.06	.954	-1.396	1.317	
Age	-.126	.073	-1.73	.083	-.268	.016	*
N_rounds	-.138	.216	-0.64	.523	-.563	.286	
NumberofFounders	.12	.104	1.15	.25	-.085	.325	
Size	.023	.107	0.22	.828	-.186	.233	
MA	1.928	.754	2.56	.011	.451	3.405	**
Seed	-.726	.606	-1.20	.231	-1.914	.461	
EarlyStageVenture	-.471	.636	-0.74	.459	-1.719	.776	
VentureRound	.313	.688	0.45	.649	-1.035	1.661	
LateStageVenture	.664	.754	0.88	.379	-.814	2.141	
CorporateRound	2.379	.719	3.31	.001	.969	3.789	***
OtherInvestments	.402	.685	0.59	.557	-.941	1.746	
lnmoneyraised	.096	.055	1.76	.079	-.011	.204	*
lnpatentsgranted	.195	.093	2.10	.036	.013	.377	**
Constant	-3.467	.902	-3.84	0	-5.236	-1.698	***
Constant	-12.369	642.059	.b	.b	-1270.782	1246.043	

Mean dependent var	0.160	SD dependent var	0.445
Pseudo r-squared	0.147	Number of obs	413
Chi-square	56.514	Prob > chi2	0.000
Akaike crit. (AIC)	371.532	Bayesian crit. (BIC)	460.048

*** p<.01, ** p<.05, * p<.1*

Table 4.8 NCVC, moderating effect of Certificates

In the last model shown in Table 9, the moderating variable *Certificates* is also added. The results obtained do not show significance for the interaction between the dependent variable and the independent variable, and furthermore, the product variable *SUST#Certificates* does not change this situation, as it has a high p-value.

4.3.3. GVC analysis

The dependent variable that is discussed now is that of the number of Government Venture Capital (*NGVC*) investments.

The following table shows the first regression for the dependent variable *NGVC*:

Negative binomial regression

NGVC	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
OECD	.095	.53	0.18	.857	-.943	1.134	
USA	-.88	.433	-2.03	.042	-1.728	-.032	**

EUROPE	-.452	.451	-1.00	.317	-1.336	.432	
ASIA	-.931	.569	-1.64	.102	-2.046	.183	
Age	.008	.052	0.16	.876	-.094	.11	
N_rounds	.59	.144	4.11	0	.309	.872	***
NumberofFounders	.084	.096	0.87	.383	-.105	.273	
Size	-.196	.113	-1.73	.084	-.418	.026	*
MA	1.307	.766	1.70	.088	-.196	2.809	*
Seed	-1.881	.393	-4.79	0	-2.65	-1.112	***
EarlyStageVenture	-1.889	.413	-4.57	0	-2.699	-1.079	***
VentureRound	-1.715	.477	-3.59	0	-2.651	-.78	***
LateStageVenture	-2.683	1.083	-2.48	.013	-4.806	-.561	**
CorporateRound	-27.182	372149.46	-0.00	1	-729426.73	729372.3	
OtherInvestments	-2.022	.531	-3.81	0	-3.063	-.982	***
lnmoneyraised	.028	.036	0.79	.431	-.042	.098	
lnpatentsgranted	.172	.121	1.42	.156	-.066	.409	
Constant	-1.122	.562	-2.00	.046	-2.224	-.02	**
Constant	-14.49	577.039	.b	.b	-1145.465	1116.486	

Mean dependent var	0.135	SD dependent var	0.374
Pseudo r-squared	0.193	Number of obs	533
Chi-square	84.873	Prob > chi2	0.000
Akaike crit. (AIC)	393.438	Bayesian crit. (BIC)	474.730

*** p<.01, ** p<.05, * p<.1*

Table 4.9 NGVCM only control variables

From the results in Table 11, it can be seen that the three control variables *OECD and EUROPE, ASIA* are not significant, in contrast to the *USA* variable which has negative significance (0.042).

The *number of Rounds* received is a factor that positively influences GVC investment (p-value 0.0), while the *Size* of startups negatively influences (p-value 0.084). The latter observation has already been seen in the literature review, as we know that Government Venture Capital often invests in very small companies, with the purpose of "Signaling" the potential of these startups, reducing their information asymmetry for others VCs (Guerini & Quas, 2016).

Information on the *Age and Number* of *Founders* of sustainable startups does not seem to influence GVCs' decisions. The variables *Seed* (p-value 0), *Early Stage Venture* (p-value 0), *Venture Round* (p-value 0), *Late Stage Venture*(p-value 0.013) and *Other Investments* (p-value 0) negatively influence GVCs' investments in sustainable startups, while *Corporate Round* has no impact on the decisions of these types of investors. This result reflects the real behaviors of GVCs, as they often make use of Grant type funding, without an obligation to repay them (Shinkle & Suchard, 2019).

The fact that the startup has made use of *M&A* strategies positively influences GVCs' investments. Finally, the amount of *Patents Granted* and *Money Raised* does not particularly affect investment by GVC.

The following table shows the second regression for the dependent variable *NGVC*:

Negative binomial regression

NGVC	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SUST	.976	.304	3.21	.001	.38	1.573	***
OECD	-.275	.566	-0.49	.627	-1.385	.834	
USA	-.615	.45	-1.37	.172	-1.498	.267	
EUROPE	-.185	.47	-0.39	.694	-1.107	.736	
ASIA	-.952	.586	-1.63	.104	-2.099	.196	
Age	-.019	.055	-0.35	.725	-.127	.088	
N_rounds	.594	.146	4.07	0	.308	.881	***
NumberofFounders	.007	.103	0.07	.943	-.195	.21	
Size	-.169	.112	-1.51	.13	-.388	.05	
MA	1.574	.772	2.04	.042	.06	3.088	**
Seed	-1.752	.401	-4.37	0	-2.538	-.966	***
EarlyStageVenture	-1.704	.421	-4.05	0	-2.529	-.88	***
VentureRound	-1.427	.492	-2.90	.004	-2.391	-.463	***
LateStageVenture	-2.271	1.094	-2.07	.038	-4.416	-.126	**
CorporateRound	-26.237	277588.26	-0.00	1	-544089.23	544036.7	
OtherInvestments	-1.875	.535	-3.51	0	-2.923	-.827	***
lnmoneyraised	.027	.036	0.74	.457	-.044	.098	
lnpatentsgranted	.124	.131	0.95	.341	-.132	.38	
Constant	-1.06	.571	-1.86	.063	-2.179	.059	*
Constant	-14.955	582.224	.b	.b	-1156.094	1126.183	

Mean dependent var	0.135	SD dependent var	0.374
Pseudo r-squared	0.214	Number of obs	533
Chi-square	94.446	Prob > chi2	0.000
Akaike crit. (AIC)	385.866	Bayesian crit. (BIC)	471.436

*** p<.01, ** p<.05, * p<.1*

Table 4.10 NGVC, control variables and SUST

The second regression model for the dependent variable *NGVC* shows an almost unchanged situation of the control variables.

Sustainability has a strong positive impact (p-value 0.001) for GVC investors, and this result suggests that startups that are considered sustainable tend to receive more investment from GVCs. Thus, sustainability emerges as an investment driver for this category of investors. This result was also expected, because the goal of GVCs, especially in recent years, is to promote cleantech technologies (Bianchini & Croce, 2022).

The following table shows the last regression for the dependent variable NGVC:

Negative binomial regression

NGVC	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
SUST	.873	.596	1.77	.043	-.094	2.041	**
Certificates	-.37	.212	-1.75	.08	-.785	.044	*

SUST#Certificates	.185	.303	0.61	.542	-.41	.779	
OECD	.068	.807	0.08	.933	-1.514	1.649	
USA	-.158	.624	-0.25	.801	-1.38	1.065	
EUROPE	.005	.556	0.01	.993	-1.085	1.094	
ASIA	-1.068	.858	-1.24	.213	-2.751	.614	
Age	-.084	.083	-1.01	.312	-.246	.079	
N_rounds	.546	.172	3.17	.002	.208	.884	***
NumberofFounders	-.05	.128	-0.39	.698	-.301	.201	
Size	-.287	.15	-1.92	.055	-.581	.006	*
MA	1.521	1.054	1.44	.149	-.545	3.587	
Seed	-1.606	.418	-3.85	0	-2.424	-.787	***
EarlyStageVenture	-1.868	.507	-3.69	0	-2.861	-.875	***
VentureRound	-1.304	.588	-2.22	.027	-2.458	-.151	**
LateStageVenture	-1.635	1.126	-1.45	.147	-3.842	.572	
CorporateRound	-3.12	1.214	-0.20	0.94	-7.356	5.167	
OtherInvestments	-1.517	.545	-2.78	.005	-2.585	-.449	***
lnmoneyraised	.059	.044	1.32	.187	-.028	.146	
lnpatentsgranted	.216	.144	1.51	.132	-.065	.498	
Constant	-.951	.839	-1.13	.257	-2.594	.693	
Constant	-15.778	855.282	.b	.b	-1692.099	1660.544	

Mean dependent var	0.136	SD dependent var	0.377
Pseudo r-squared	0.258	Number of obs	413
Chi-square	88.309	Prob > chi2	0.000
Akaike crit. (AIC)	298.024	Bayesian crit. (BIC)	386.540

*** p<.01, ** p<.05, * p<.1*

Table 4.11 NGVC, moderating effect of Certificates

In the last analysis in Table 13, the effect of the moderation variable *Certificates* was added. In this case, *Sustainability* continues to be significant and positive (p-value 0.043) for GVCs' investment decisions. *Certificates* have a weakly significant (p-value 0.08) but negative impact. This means that the presence of *Certificates* in startups is associated with fewer investments by GVCs. This could be given by a distorted view of startups on the use of Certificates: this type of government policy could be used primarily to avoid fines and to meet regulatory requirements imposed by Certificates, rather than on the real desire to grow the company with a sustainable vision.

Finally, the product variable SUST#*Certificates* is not significant. This indicates that the positive impact of sustainability is not further amplified by the effect of the moderating variable *Certificates*.

5. CONCLUSION

The climate crisis is one of the most pressing challenges of our time. The urgent need to transform our economy towards greater environmental sustainability is supported by scientific evidence. Governments, states, the European Union and the OECD are implementing measures and policies to support the shift to a more sustainable economy in this setting. This transformation is not only an environmental imperative but also an opportunity to promote innovation, economic growth and the well-being of societies around the world.

Sustainable startups are emerging as key players in this transition. These businesses, which are frequently started by visionary business owners, are essential to the creation of new technology and creative responses to environmental problems. They serve as incubators for innovation, places in which cutting-edge concepts and visions for a sustainable future are developed.

However, sustainable startups face many obstacles regarding seeking funding. Due to the uncertainty of projects related to sustainability, technical risks, the long-term nature of environmental objectives and longer investment returns, investors may be reluctant to support these startups.

This study analyzes the convergence between sustainable innovation and investments of three types of Venture Capital: Independent Venture Capital (IVC), Corporate Venture Capital (CVC) and Government Venture Capital (GVC).

The main objective was to explore whether the *sustainability* of startups could be an element of attraction for these investors, and understanding how Certificates may affect VCs decisions to invest in sustainable startups. The econometric analysis conducted in this study reveals several interesting dynamics from which conclusions can be drawn.

First, *Sustainability* appears to negatively influence Independent Venture Capital (IVC) investments. This result can be interpreted as reflecting the characteristics of this type of investor: financial return and short-term goals. Sustainabilit*y*, on the other hand, is a very expensive and long-term goal for sustainable startups (Colombo & Murtinu, 2015, Hockerts 2010).

However, when the *certificates* moderation variable is introduced, we observe that sustainability always has a negative effect on IVC investments, and the situation does not change because certificates do not affect the dependent variable IVC either directly or through the moderation with Certificates.

As for Corporate Venture Capital (CVC), they seem to be less interested in investing in sustainable startups, and this trend does not seem to change even when the moderating role of *Certificates* is added. Although CVC investors do not look at a pure financial return, because their main goal is to have a strategic update, it seems that they do not ignore this aspect (Wang, 2022). In fact, even if sustainable startups could offer long-term benefits in terms of environmental sustainability, they could still be a barrier to immediate financial returns. The presence of *Certificates* does not seem to be sufficient to change this dynamic. The environmental policies represented by *Certificates* do not sufficiently incentivize CVCs toward such investments.

Regarding Government Venture Capital (GVCs), we note that *sustainability* plays a key role in their investment decisions (p-value 0.001). This result is in line with the behavior of GVCs, as these government funds go beyond mere financial profit. They tend to pursue public interest goals such as the environment by supporting sustainable startups through grants or investments, with no obligation to repay. Here the purely supportive role of GVCs is evident, unlike the other two types of VCs, in that they do not seek financial return (Bianchini & Croce, 2022).

The moderating effect of *Certificates* showed no significance, not modifying the positive effect of the independent variable Sustainability. This could be explained because sustainability is already at the core of their investment decisions, GVCs do not need additional incentives such as *Certificates* to guide their choices.

Finally, it is interesting the result of the influence of the Certificates variable directly on GVC investments, not considering only the sustainability factor: in fact, the results show a slight negative impact on this type of investment (p-value 0.08). This result could be a result of the view that Government Venture Capital has on those who make use of programs such as the CO2 Trading Scheme and the Renewable Energy Trading Scheme. Startups might feel obligated to invest in sustainability, mainly to avoid fines or to meet regulatory requirements imposed by Certificates. This might make it appear that investments in sustainability are not intrinsically motivated by the startup's vision or growth strategy, but rather by external economic incentives.

This study is an important contribution to the literature regarding the influence of startups' sustainability and environmental policies on Venture Capital behavior. In fact, the results from this study confirmed that sustainability has an influence on investors' choices. Finally, although The Certificates have a direct influence on the investment decisions of GVCs, we can conclude

that at present this government policy does not have much influence on the likelihood of sustainable startups to receive investment from IVC, CVC, and GVC investors.

5.1. Limitations

The limitations of this study mainly focus on the sample construction. In fact, only 24 startups out of the 368 analyzed are sustainable. This is mainly due to the lack of information of startups in the sample before the aggregation.

Another problem is due to the 171 missing observations of the moderation variable *Certificates*. This is mainly caused by the OECD datased for the EPS index, which collected data up to 2020.

In the future it would be convenient to fill these limitations by obtaining more information on startups and getting a new update of the EPS index.

6. REFERENCES

Ali, L. (2021). Faculty of Science and Engineering Discipline of Electrical and Computer Engineering Development and Improvement of Renewable Energy Integrated with Energy Trading Schemes based on Advanced Optimization Approaches.

Battisti, E., Nirino, N., Leonidou, E., & Thrassou, A. (2022). Corporate venture capital and CSR performance: An extended resource based view's perspective. Journal of Business Research, 139, 1058–1066. https://doi.org/10.1016/j.jbusres.2021.10.054

Baum, J. A. C., & Silverman, B. S. (2004). Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology startups. Journal of Business Venturing, 19(3), 411–436. https://doi.org/10.1016/S0883-9026(03)00038-7

Bendig, D., Kleine-Stegemann, L., Schulz, C., & Eckardt, D. (2022). The effect of green startup investments on incumbents' green innovation output. Journal of Cleaner Production, 376. https://doi.org/10.1016/j.jclepro.2022.134316

Bergset, L., & Fichter, K. (2015). Green start-ups-a new typology for sustainable entrepreneurship and innovation research. Journal of Innovation Management Bergset, Fichter JIM, 3, 118–144. http://www.open-jim.orghttp://creativecommons.org/licenses/by/3.0

Bertoni, F., & Tykvová, T. (2015). Does governmental venture capital spur invention and innovation? Evidence from young European biotech companies. Research Policy, 44(4), 925–935. https://doi.org/10.1016/j.respol.2015.02.002

Bianchini, R., & Croce, A. (2022). The Role of Environmental Policies in Promoting Venture Capital Investments in Cleantech Companies. https://doi.org/10.1561/114.00000024_app

Block, J. H., Fisch, C. O., Obschonka, M., & Sandner, P. G. (2019). A personality perspective on business angel syndication ☆. Journal of Banking and Finance, 100, 306–327. https://doi.org/10.1016/j.jbankfin.2018.10.006

Boar-Boar, A., & Oliveras-Villanueva, M. (2019). Systematic Literature Review: Sustainability practices in Start-ups. In EUROPEAN ACCOUNTING AND MANAGEMENT REVIEW (Vol. 6).

Bocken, N. M. P. (2015). Sustainable venture capital - Catalyst for sustainable start-up success? Journal of Cleaner Production, 108, 647–658. https://doi.org/10.1016/j.jclepro.2015.05.079

Bogers, M., Chesbrough, H., & Strand, R. (2020). Sustainable open innovation to address a grand challenge : Lessons from Carlsberg and the Green Fiber Bottle. British Food Journal, 122(5), 1505–1517. https://doi.org/10.1108/BFJ-07-2019-0534

Bogers, M., Zobel, A. K., Afuah, A., Almirall, E., Brunswicker, S., Dahlander, L., Frederiksen, L., Gawer, A., Gruber, M., Haefliger, S., Hagedoorn, J., Hilgers, D., Laursen, K., Magnusson, M. G., Majchrzak, A., McCarthy, I. P., Moeslein, K. M., Nambisan, S., Piller, F. T., … Ter Wal, A. L. J. (2017). The open innovation research landscape: established perspectives and emerging themes across different levels of analysis. Industry and Innovation, 24(1), 8–40. https://doi.org/10.1080/13662716.2016.1240068

Boris Mrkajic, S. M. (2019). Is green the new gold? Venture capital and green entrepreneurship. Small Business Economics .

Bos-Brouwers. (2010). Corporate sustainability and innovation in SMEs: Evidence of themes and activities in practice.

Botta, E., & Koźluk, T. (2014). Measuring Environmental Policy Stringency in OECD Countries: A Composite Index Approach. https://doi.org/10.1787/5jxrjnc45gvg-en

Carmen Cotei & Joseph Farhat. (2018). The M&A exit outcomes of new, young firms. Small Business Economics .

Chesbrough, H. (2006). Open Innovation: A New Paradigm for Understanding Industrial Innovation. Oxford University Press.

Chesbrough, H. (2012). Open innovation: Where we've been and where we're going. In Research Technology Management (Vol. 55, Issue 4, pp. 20–27). https://doi.org/10.5437/08956308X5504085

Chesbrough, H. W. (2003). Open Innovation The New Imperative for Creating and Profiting from Technology (Vol. 658).

Colombo, M. G., Cumming, D. J., & Vismara, S. (2016). Governmental venture capital for innovative young firms. Journal of Technology Transfer, 41(1), 10–24. https://doi.org/10.1007/s10961-014-9380-9

Colombo, M. G., & Murtinu, S. (2015). Venture Capital Investments in Europe and Portfolio Firms' Economic Performance: Independent versus Corporate Investors.

D. Hegeman & Sørheim. (2021). Why do they do it? Corporate venture capital investments in cleantech startups. Journal of Cleaner Production.

De Lange, D. V. (2019). Sustainable firms and legitimacy: Corporate venture capital as an effective endorsement. Journal of Small Business Management .

Dixon-Fowler, H. R., Slater, D. J., Johnson, J. L., Ellstrand, A. E., & Romi, A. M. (2012). Archived version from NCDOCKS Institutional Repository Beyond "'Does it Pay to be Green?'" A Meta-Analysis of Moderators of the CEP-CFP Relationship. https://doi.org/10.1007/s10551

Dushnitsky, G., & Lenox, M. J. (2005). When do incumbents learn from entrepreneurial ventures?: Corporate venture capital and investing firm innovation rates. Research Policy, 34(5), 615–639. https://doi.org/10.1016/j.respol.2005.01.017

F Michelino, M. C. A. C. (2014). Inbound and outbound open innovation: organization and performances. Journal of Technology Management & Innovation.

Giulio Cainelli, V. D. M. (2015). Does the development of environmental innovation require different resources? Evidence from Spanish manufacturing firms. Journal of Cleaner Production.

Guerini, M., & Quas, A. (2016). Governmental venture capital in Europe: Screening and certification. Journal of Business Venturing, 31(2), 175–195. https://doi.org/10.1016/j.jbusvent.2015.10.001

Hockerts, K., & Wüstenhagen, R. (2010). Greening Goliaths versus emerging Davids - Theorizing about the role of incumbents and new entrants in sustainable entrepreneurship. Journal of Business Venturing, 25(5), 481–492. https://doi.org/10.1016/j.jbusvent.2009.07.005

Holger Patzelt Dean A. Shepherd. (2011). Recognizing Opportunities for Sustainable Development.

Hollensbe, E., Wookey, C., Hickey, L., & George, G. (2014). Organizations with purpose. In Academy of Management Journal (Vol. 57, Issue 5, pp. 1227–1234). Academy of Management. https://doi.org/10.5465/amj.2014.4005

Ioannis Ioannou and George Serafeim. (n.d.). The Business Case for Corporate Sustainability: Literature Review and Research Options.

Jannic Horne, K. F. (2022). Growing for sustainability: Enablers for the growth of impact startups – A conceptual framework, taxonomy, and systematic literature review. Journal of Cleaner Production.

Keuschnigg, C. (2002). VENTURE CAPITAL BACKED GROWTH. www.CESifo.de

Kimpimäki, J. P., Malacina, I., & Lähdeaho, O. (2022). Open and sustainable: An emerging frontier in innovation management? Technological Forecasting and Social Change, 174. https://doi.org/10.1016/j.techfore.2021.121229

Kruse, T., Dechezleprêtre, A., Saffar, R., & Robert, L. (2022). Measuring environmental policy stringency in OECD countries: An update of the OECD composite EPS indicator. https://doi.org/10.1787/90ab82e8-en

Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. Strategic Management Journal, 27(2), 131–150. https://doi.org/10.1002/smj.507

Lee, K. H., & Kim, J. W. (2011). Integrating suppliers into green product innovation development: An empirical case study in the semiconductor industry. Business Strategy and the Environment, 20(8), 527–538. https://doi.org/10.1002/bse.714

Linnanen, L. (2002). An insider's experiences with environmental entrepreneurship. Greener Management International, 38, 71–80. https://doi.org/10.9774/GLEAF.3062.2002.su.00008

Luukkonen, T., Deschryvere, M., & Bertoni, F. (2013). The value added by government venture capital funds compared with independent venture capital funds. Technovation, 33(4–5), 154–162. https://doi.org/10.1016/j.technovation.2012.11.007

M Hossain. (2013). Open innovation: so far and a way forward. World Journal of Science, Technology and Sustainable Development.

Makri, M., Hitt, M. A., & Lane, P. J. (2010). Complementary technologies, knowledge relatedness, and invention outcomes in high technology mergers and acquisitions. Strategic Management Journal, 31(6), 602–628. https://doi.org/10.1002/smj.829

Malte Brettel, N. J. C. (2011). Innovation Culture, Collaboration with External Partners and NPD Performance.

Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. Research Policy, 41(6), 955–967. https://doi.org/10.1016/j.respol.2012.02.013

Mazzola, E., Bruccoleri, M., & Perrone, G. (2016). Open innovation and firms' performance: state of the art and empirical evidences from the bio-pharmaceutical industry. In Technology Analysis & Strategic Management, and International Journal of Innovation Management (Vol. 70, Issue 3).

Orlitzky, M., Schmidt, F. L., & Rynes, S. L. (2003). Corporate Social and Financial Performance: A Meta-analysis. www.sagepublications.com

R Goodland. (1995). The concept of environmental sustainability.

Rauter, R., Globocnik, D., Perl-Vorbach, E., & Baumgartner, R. J. (2019). Open innovation and its effects on economic and sustainability innovation performance. Journal of Innovation and Knowledge, 4(4), 226–233. https://doi.org/10.1016/j.jik.2018.03.004

Shepherd, D. A., & Patzelt, H. (2011). The New Field of Sustainable Entrepreneurship: Studying Entrepreneurial Action Linking "What Is to Be Sustained" With "What Is to Be Developed." Entrepreneurship: Theory and Practice, 35(1), 137–163. https://doi.org/10.1111/j.1540-6520.2010.00426.x

Shinkle, G. A., & Suchard, J. A. (2019). Innovation in newly public firms: The influence of government grants, venture capital, and private equity. Australian Journal of Management, 44(2), 248–281. https://doi.org/10.1177/0312896218802611

Wadhwa, A., Phelps, C., & Kotha, S. (2016). Corporate venture capital portfolios and firm innovation. Journal of Business Venturing, 31(1), 95–112. https://doi.org/10.1016/j.jbusvent.2015.04.006

Wang, S. (2022). Efficient Venture Capital Market Theory of Convertibles View project Organization View project Efficient Venture Capital Market. https://www.researchgate.net/publication/357536302

York, N. (2011). Sixth Meeting of the UN Committee of Experts on Environmental-Economic Accounting Towards Green Growth: Monitoring Progress Towards Green Growth: Monitoring progress OECD INDICATORS.